Comparative SEM-EDX study of *Mangifera Indica L.* leaves for more production of fruits from selected areas of Kachchh and Saurashtra region

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Abstract - The mango fruit, scientifically known as *Mangifera Indica L.*, is renowned in the Indian market for its exquisite exotic flavors. Gujarat state is particularly recognized for its extensive mango production. In this research, we employed SEM and EDAX analysis to examine the influence of calcium (Ca) and chromium (Cr) in two distinct types of mango leaves collected from different regions within Gujarat state, namely Saurashtra and Kachchh. The concentration of elements in the soil and leaves can impact fruit quality and yield. The presence of chromium in the leaves of Saurashtra region affects vital physiological processes in plants, such as mineral nutrition, water-related properties, and photosynthesis. Calcium, on the other hand, is an essential macronutrient that plays a crucial role in various biochemical and physiological functions of plants. It has been found to significantly influence postharvest fruit quality and ripening. Notably, the leaves from the Kachchh region contain a substantial amount of calcium, which may enhance the flavor and sweetness of the fruit compared to those from Saurashtra. Additionally, both types of leaves were subjected to phytochemical screening, revealing their potential utility in the treatment of various illnesses.

Keywords: ***calcium and chromium in mango, EDX elemental analysis, SEM image, Phytochemical screening***

I. INTRODUCTION

The mango, *Mangifera Indica L.*, has been used in Ayurvedic and traditional medicine systems for 4,000 years and is well renowned for its delicious unusual flavour[1]. The mango (*Mangifera indica Linn.*), a tropical fruit with significant commercial value, is an in deliquescent drupe with a single big seed enclosed in fleshy mesocarp. Mango, a dicotyledonous fruit of the family Anacardiaceous, originated in the Indo-Burmese region[2]. India's most significant fruit crop in terms of trade is the mango, of which there are more than a thousand identified varieties[3]. Mango's flowering is preceded by the flower bud's differentiation in the shoots. Varied varieties have different periods of differentiation, which are also influenced by the local climatic conditions. After pollination and fertilization, the hermaphrodite flowers of the mango in florescence produce fruit. Mango trees have an enormous potential to yield fruits. Mature trees produce up to 1000 inflorescence each with 500–6000 flowers [4].

The growth of plants and its fruit yield is highly influenced by environmental pollution as well as toxic effects of industrial wastes to the farms[5-7]. In the present analysis, comparison studies of soil and leaves of Mangifera Indica

L. of Saurashtra and Kachchh region carried out using SEM and EDX analysis. The SEM-EDX data shown the healthy leaves and diseased leaves of Saurashtra and Kachchh region with elementary concentration. Surface analysis using scanning electron microscopy is used to display the topography of the sample that was obtained [8-11].

II. MATERIALS AND PROCESSING

2.1 SAMPLE COLLECTIONS

The samples collect from two different area of Gir-Somnath(Taluka – Kodinar, village – Kantala(20.910273042888832, 70.72446519581729), and Taluka – Talala, village – Ratidhar(20.964867028537274, 70.62403147343709)) and another from Bhuj district(Taluka–Bhuj , village–Bharapar(23.13723789071294, 69.63497065392794)).

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2.2 Soil, and *Mangifera Indica L.* leaves sample preparation

To collect a soil sample, remove grass, detritus, and other material from the top without disturbing the soil and dig a 15 to 20 cm deep "V"-shaped trench using a shovel or hoe.

Gather soil from the top to the bottom of an equal-thickness layer. Take a sample from 10 to 12 different locations, gather all of the soil, and thoroughly mix it. Repeat until the soil sample is packed in a sturdy cloth or polythene bag for examination.

The leaves will then be cleaned and rinsed with distilled water before being dried(Figure 1). The leaves will then be pulverized and placed in airtight plastic containers for ongoing studies. Soil samples can also be dried naturally or in an oven. Also available in powder form from the grinder machine. and kept in airtight plastic containers for ongoing studies.

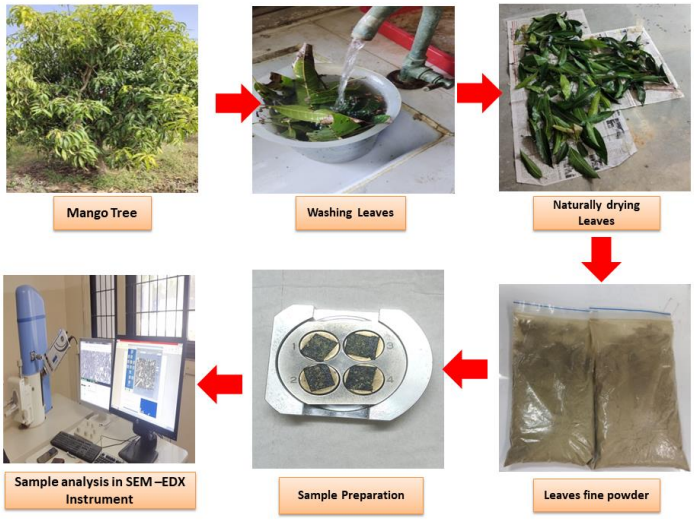

Figure 1. Leave sample preparation

III. RESULT AND DISCUSSION

3.1 Soil and water analysis of Saurashtra and Kachchh

Table 1 summaries the soil analyses of the Saurashtra and Kachchh regions. According to the soil data, the potassium and nitrogen concentrations in soil were higher in Saurashtra (K= 721 Kg/Hectare, N= 544.40Kg/Hectare) than in Kachchh (K= 228.63 Kg/Hectare, N=330Kg/Hectare). The water analysis of Saurastra and Kachchh revealed that the pH of Saurastra has become less basic than that of Kachchh region and in case of conductivity, Kachchh water (2.20 S/cm) is more conducting than the Saurastra water(1.05 S/cm)(Table 2).

Table 1. Soil analysis of Saurashtra and Kachchh region

Region	pH	EC(µS/cm)	K(Kg/Hectare)	OC (%)	N(Kg/Hectare)
Kachchh	7.36	0.04	228.63	0.85	330.00
Saurashtra	7.80	0.32	712.18	3.00	544.40

Table 2. Water analysis of Saurashtra and Kachchh region

Region	Village	pH	EC(µS/cm)	TDS(ppm)
Kachchh	Bharapar	7.62	2.20	840
Saurashtra	Kantala	7.35	1.05	460

3.2 Soil analysis of Saurashtra and Kachchh region from SEM-EDX technique

The EADX study showed that metals (Mg Al, Ca, Tb) are more abundant in Saurashtra water, whereas Si, P, K, Ti, and Fe are more abundant in Kachchh water(Figure 2). The Si metal have same concentration in both the soil sample of Saurashtra and Kachchh region.

3.3 *Mangifera Indica L.* leaves analysis of Saurashtra and Kachchh region from SEM-EDX technique

Elemental research indicates that chromium(Cr) is present in the leaves of the Saurashtra area but not in the leaves of the Kachchh region. Fruit from the Kachchh area has been shown to be sweeter than fruit from the Saurashtra region. In the elemental content of both locations, chromium is found to be more abundant in Saurashtra, but healthy leaves in Kachchh have a higher concentration of calcium(Ca). Nevertheless, K, Mg, Ca, and Si are found in all of the variations. In case of disease *Mangifera Indica L.* leaves in Kachchh region, Sb concentration is more compared to health leave.

Numerous studies and reviews have demonstrated that several variables are responsible forthe availability, toxicity and accumulation of elements in the roots, leaves and fruits of plants. They might be due to environmental contamination induced by environmental impacts or industrial wastes provided by different human activities towards urbanization. The most prevalent oxidation states of chromium are Cr (0, III, VI)[12-14]. Cr(VI) is discovered to be more hazardous than Cr(III) in the form of its chromate and dichromate[15]. According to WHO, 2003, hexavalent chromium is more soluble and so more mobile, and thus more common in soil than Cr(III). The major source of excess Cr in soil and farms is industrial effluent from textile, steel, and leather manufacture, electro painting, and chromium chemical uses, among other things Moreover, clay particles and soil physicochemical parameters influence the availability and accumulation of heavy metals[16, 17] claim that soil pH has a significant impact on the transport of heavy metals. It has been shown that plants have less access to micronutrients when the pH is alkaline[18]. Metal ions and H+ compete for the ligands in soils with an acidic pH. Owing to this competition, metals' ability to bind to soil particles is reduced, which in turn causes heavy metals to move throughout the soil more easily, increasing the availability of those metals there. When critical micronutrients were not available to plants, they instead take these heavy metals from the soil[19].

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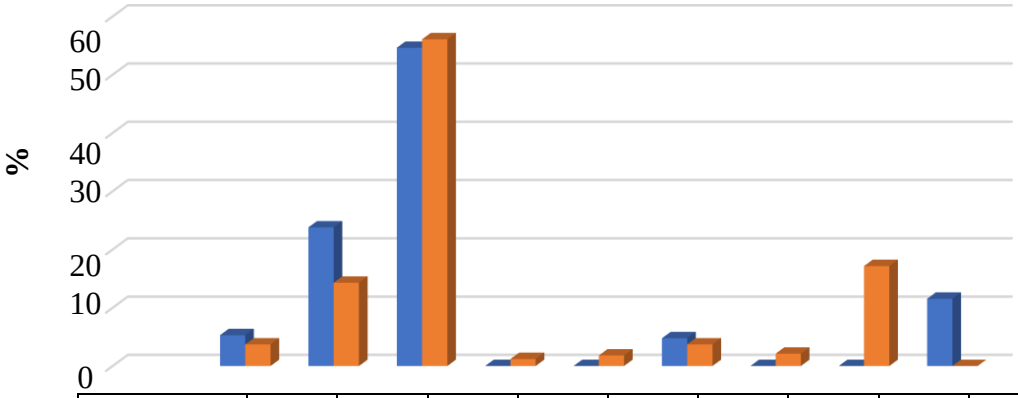
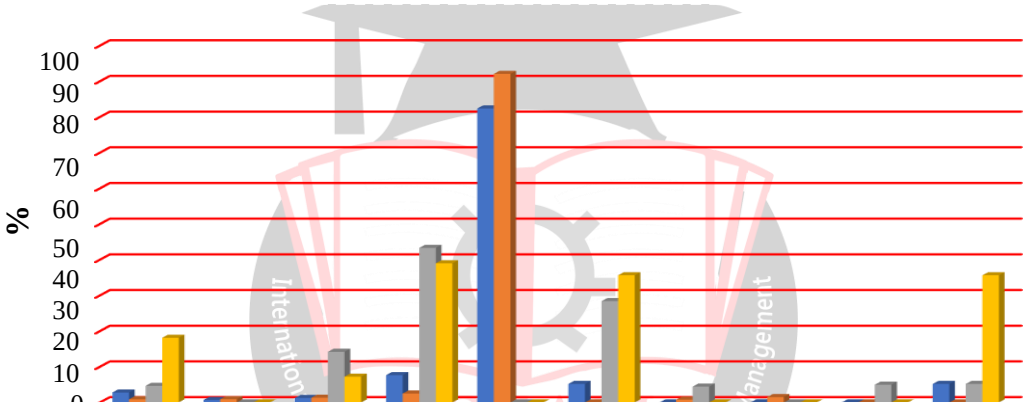
The SEM image of health and disease leave of both regions were shown in **Figure 3**. Healthy soil and *Mangifera Indica L*. leaves from Saurashtra and Kachchh were subjected to surface morphology analysis using SEM; the results are presented in **Figure 4.**

Figure 4. SEM image of (a) Saurastra *Mangifera Indica L.* leaves, (b) Kachchh*Mangifera Indica L.* leaves, (c) Saurashtra soil and (d) Kachchh soil



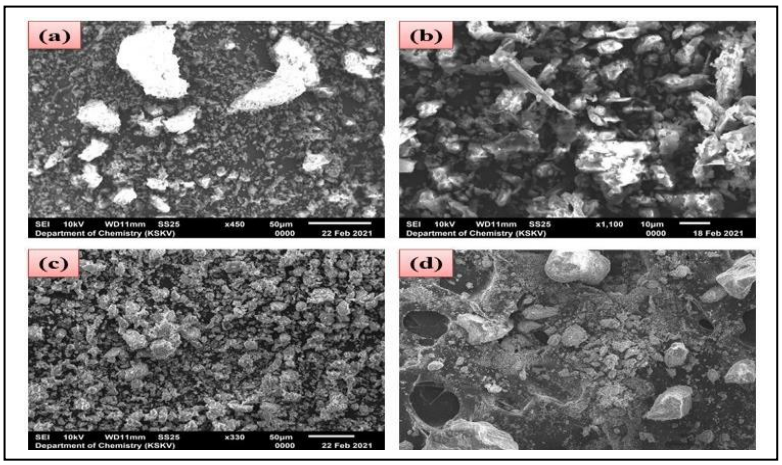
	Mg	Al	Si	P	K	Ca	Ti	Fe	Tb
Saurashtra	5.29	23.79	54.61	0	0	4.77	0	0	11.54
Kachchh	3.69	14.29	56.07	1.2	1.8	3.69	2.11	17.15	0

Figure 2. Elemental(EDX) weight percentage(%) in Saurashtra and Kachchh soil sample



	Si	S	K	Ca	Cr	Sb	Mg	P	Cl	Sb
Saurashtra healthy leaves	2.78	0.7	1.26	7.66	82.39	5.2	0	0	0	5.2
Saurashtra disease leaves	0.89	0.91	1.34	2.51	92.09	0	0.78	1.5	0	0
Kachchh healthy leaves	4.65	0	14.2	43.31	0	28.41	4.45	0	4.98	5.2
Kachchh weak leaves	18.12	0	7.23	39	0	35.65	0	0	0	35.65

Figure 3. Elemental (EDX) weight percentage (%) in Saurashtra and Kachchh soil sample



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3.4 Phytochemical screening of *Mangifera Indica L.* leaves powder

The Phytochemical screening, carbohydrates is presence in Kachchh leave but not in Saurashtra leave its indicated that Kachchh *Mangifera Indica L.* leave rich in carbohydrates are considered to be of low nutritional value compared to Saurashtra *Mangifera Indica L.* leaves Carbohydrates are utilised in pharmacy for the preparation of sucrose as binders for the preparation of tablets (lactose), and in anti-diarrhoea drugs (pectin), antacids, diuretic drugs (mannitol and sorbitol), etc[20]. The Phytochemical screening indicated that the both the Saurashtra and Kachchh leave have Saponins and tannin in leave and Clinical studies have suggested that the Saponins are health- promoting components, affect the immune system in ways that help to protect the human body against cancers, and also lower cholesterol levels as well as decrease blood lipids, lower cancer risks, and lower blood glucose response[21]. Both regions leaves included alkaloids, flavonoids and terpenoids which suggests that both leaves had anti-oxidative, anti-inflammatory, anti- mutagenic, and anti-carcinogenic qualities and alkaloids they may be used to cure a variety of illnesses, including malaria, diabetes, cancer, heart dysfunction, and platelet disorders [22-23]. According to Table 3, The Kachchh leave have high concentration of quinones and anthraquinones are bioactive natural products, some of which are active components in medicinal medicines, especially Chinese medicines. These compounds exert actions including purgation, anti-inflammation, immunoregulation, antihyperlipidemic, and anticancer effects[24]. From this study, it can be deduced that *Mangifera Indica L.* extracts have various medicinal values due to the presence of a variety of phytochemicals. As reported from previous studies [25–26], all the phytochemical compounds found in the leaves of this plant has been reported to have beneficial health effects on humans.

IV. Conclusion

The elemental composition of the leaves of *Mangifera Indica L.* is revealed by SEM-EDX analysis. Healthy leaves from the Kachchh area have a higher amount of calcium than weak leaves in the current study. Also, it was discovered that the fruit quality was sweeter than that of Saurashtra. This could be explained by the high calcium content of Kachchh area leaves. Yet, the high levels of chromium in the Saurashtra region's leaves have an impact on a number of physiological processes in plants, lowering fruit output and taste. The texture and color of *Mangifera Indica L.* fruit can be improved with the usage of different calcium salts, which is recommended to improve fruit quality. The Saurashtra *Mangifera Indica L.* leave have high concentration of flavonoid, terpenoids and Kachchh *Mangifera Indica L.* leave have high concentrations of quinone and anthraquinone indicated that the both leaves are useful in different- different illnesses.

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Table 3. Phytochemical screening *Mangifera Indica L.* leaves

	Leaves extracts of Saurashtra region			Leaves extracts of Kachchh region		
Type of test	**n-hexane**	**Acetone**	**Methanol**	**n-hexane**	**Acetone**	**Methanol**
Carbohydrae	-	-	-	-	-	+
Tannine	-	+	+	-	-	+
Saponine	+	-	+	-	-	+
Alkaloids	++	++	++	++	++	++
Flavonoids	+	+	+	-	+	+
Terpenoids	+	+	+	-	+	+
Quinones	-	-	-	++	++	++
Anthraquinones	-	-	-	+	+	+

Note: ++ =strongly positive, + = positive, - = not detected

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